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ABSTRACT

This study was designed to investigate whether direct instruction applied as a main-instructional strategy with a focused curriculum could help students quickly improve their math basic skills. Nineteen students aged 7-16 years old with math problems received individualized treatments for 3 weeks or 12 hours using pre-test, treatments, post-test as the basic design. Results showed that after the treatments, the students made significant gains in their math basic skills with an average gain of approximately 2.0 in Grade Equivalent score. Findings suggest that the integrated direct instruction approach, when used appropriately, can be both effective and efficient in helping students improve their math basic skills. Contains 12 references. (Author)

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Direct Instruction in Remedial Math Instructions

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Abstract

The study was designed to investigate whether direct instruction, applied as a main instructional strategy, with a focused curriculum, could help students quickly improve their math basic skills. Nineteen students (age 7-16 years old) with math problems received individualized treatments for three weeks (or 12 hours). Pre-test, treatments, post-test was the basic design. Results showed that after the treatments, the students made significant gains in their math basic skills, with an average gain of approximately 2.0 in Grade Equivalent score. The findings suggest that the integrated direct instruction approach, when used appropriately, can be both effective and efficient in helping students improve their math basic skills.

Direct Instruction in Remedial Math Instructions

Children with math deficiencies face not only academic problems but also practical problems every day. For these children, math problems often result in school failures and living problems: Daily living also requires numerous math skills, such as planning time, measuring a variety of things, making estimations, shopping, etc. Research literature indicates that math problems emerge in the early years and are common at all age levels (Mercer & Mercer, 1993).

Facing the fact that a large number of school children are below their actual grade level in math, researchers and educators have been searching for effective ways to help school children improve their math skills. The direct instruction strategy has been considered effective in teaching math basic skills, factual knowledge and concept name identification (Jones & Cooper, 1987). Pendarvis and Howley (1988) identified four major elements that had been shown to contribute to students' improved performance: (1) the emphasis on acquisition of concepts; (2) the use of mediators, including verbal, visual, and semantic mediators, to enhance students' schema development; and (3) the use of active learning and direct instruction techniques; (4) the development of cognitive skills. Direct instruction was one of the four elements identified to have contributed to students' improved performance.

Current research literature has provided evidence, although limited, on the effectiveness of direct instruction in teaching

various math basic skills to diverse student bodies. The effect of direct instruction in raising the mastery of math related language-concepts for beginning first graders was investigated by Lambert and Pearson (1986). It was found that with direct instruction of language concepts, the experimental group did better on the post-test than the control group on 7 out of 13 concepts.

A concentrated, direct instruction in reading and math program was provided to 27,944 students receiving Chapter 1 basic services in Maine. Some of these students also received support services: such as counseling, guidance and transportation. Pre- and post-tests for assessing students' basic and advanced skills in reading and math showed academic gains in normal curve equivalent (NCE) units. Average gains in Fiscal Year 1991 and 1992 ranged from 1.9 to 7.77 NCEs (Maine State Department of Education, 1992).

Direct instruction has also been applied to teaching middle grade low-achieving migrant students who were 2 to 4 years behind their language peers. A 19-day curriculum consisting of 80 to 95 hours of direct instruction was implemented with this group of children in California. The pre- and post-test results showed student growth in all four areas: attitudes toward math and science, metric system skills, observation skills and scientific method skills (Ochoa, 1994).

In a study for compared effects of token reinforcement, cognitive behavior modification and direct instruction, ninety

four students with learning disabilities received a treatment (one hour per day treatment) for four weeks. Significant gain was found in achievement test scores for the token reinforcement and direct instruction groups (Ross & Braden, 1991).

Based on their 10-year research program, Kitz and Nash (1995) found that the most effective means of helping dyslexic college students was a well-planned curriculum and high quality instruction. A structured curriculum was the most effective means of helping them learn basic and fundamental algebra skills. Their practices included direct instruction, standard lesson designs, mastery learning, use of manipulative materials in problem solving and training in math expressions.

In searching for a way to improve math and reading basic skills of correctional pre-trial detainees, Winters, Mathew, Booker, and Fleeger (1993) found that a system that integrated TABE assessment and evaluation, computer assisted instruction, direct instruction and an individualized curriculum was the most appropriate instructional program for meeting the educational needs of adult offenders. It appears that this combined approach works effectively in helping learners from diverse background improve math skills.

The purpose of the study was to investigate whether direct instruction, applied as a main instructional strategy, with a focused curriculum, could help students quickly improve their basic skills in math.

Method

The study was designed to help students with severe math deficiencies: They were 1 to 4 grades below their actual grade level in math. None of these children was identified for special education services at the time of receiving treatments in this project. A faculty member (project director) in special education in a college located in the Appalachia Mountains area organized the project as a free summer program. The basic design of the project took the form of pre-test, treatments, and post-test.

Subjects

Nineteen students (10 boys, 9 girls, age range--7 to 16 years old) participated in the project. All the students were referred by their parent(s), because they were having real troubles in math. These students were from middle/lower middle class, Caucasian families.

Teachers

The participating teachers were the pre-service teachers (4th and 5th year) majoring in the college's special education program, who volunteered to help a child improve his/her math skills for five weeks.

Treatments

The project utilized a one-on-one approach--one teacher helping one student throughout the whole process. In this project, each student received focused treatments (mainly instructions) in the problem areas she or he exhibited: numeration concept, various computation procedures,

multiplication table and its applications, etc.

Direct instruction was used as the main instructional strategy in the study. In addition, the teachers used the following methods: review, clarification, repeated instruction, drill and practice, continuous monitoring of the child's progress, continuous adjustment of teaching method and curriculum content, etc. The teachers also tried to maintain a rapport with the student she/he taught throughout the project. Positive reinforcement was applied in the process: such as using tangibles and praise, etc.

The instructional materials used in the project were selected by each teacher based on the assessment results. Basically, the materials were selected based on the present achievement level and problem areas shown by each student.

Procedures

The duration of the project was five weeks. The first week was used for teacher training--preparing the participating teachers on: how to assess a child's present achievement level in math; how to develop an instructional plan (including selection of instructional materials) for a student; and how to use direct instruction as a main instructional strategy to help a student improve the problem areas. The teacher training lasted for two hours (completed in one day). Two days were used for assessing the group of students. One day was used by each teacher to develop the instructional plan. The next three weeks were for treatments. The fifth week was used for post-testing, the

teachers preparing a brief report for the parents, and summarizing the project.

Each teacher developed an instructional plan for one student. Each plan was examined by the project director before it was implemented. During the treatment period, each teacher received feedback from the project director on how to apply the teaching methods appropriately and how to adjust the instructional content she/her was teaching. Necessary adjustments to the teaching methods and instructional content were made by each teacher to ensure the effective learning of each student.

Each student received mostly one hour treatments each session, sometimes 30 minutes a session. They all received four hours (minimum) of treatments per week. Most of them received 12 hours of individualized treatments. A few students received 5 or 6 hours of treatments per week, because several teachers volunteered to spend more time working with the students. However, all treatments were provided during the three weeks. Each teacher also recorded what occurred during each treatment session as a monitoring procedure.

Instrument

Each student was administered the math sub-test of the Wide Range Achievement Test-R (WRAT-R) for pre- and post-test. A test made by each teacher was also given to each student. This was to check on whether the problems a student exhibited on the pre-test were similar to what the teacher found on the teacher-made test. Test items on the teacher-made tests were designed by each

teacher according to the problems shown by each student on the WRAT-R test. It was to find out whether the student really had such problems.

Term definition

Basic math skills in this study refers to: numeration concepts, computation procedures, knowledge and use of multiplication table, application of the skills to problem solving.

Direct instruction is defined as an instructional sequence that includes demonstration, controlled practice with prompts and feedback, independent practice with feedback (Mercer, 1997, p. 277). This strategy comprises all six features defined by the researchers at the University of Oregon (Mercer, 1997, pp. 275-76).

Results

After a three-week focused treatments, a post-test was administered to each student. Every student in the project made notable progress. A summary report was provided by the teachers to the parents of each student, and suggestions were made to them on the necessity of providing continued help to the student. Main findings follow.

A Dependent *t* test was conducted on the raw scores of the pre- and post-test scores of this group of students. Results indicated that significant gains were found with the post-test results. The comparison yielded a *t* value at 22.75, with $p < .000$, two-tailed.

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The average Grade Equivalent (GE) scores of the two testings also showed improvement: the average GE score for the pre-test was 3.58, and that for the post-test was 5.53.

Discussion

The direct instruction strategy applied in this study should be considered as part of the program. A highly controlled curriculum was also integrated. Without a curriculum that matched the student's knowledge and skill level and focused instructions, it is unlikely that the students could gain so much in such a short time. This approach (direct instruction with a curriculum design) is similar to the definition of Kameenui, Jitendra and Darch (1995) for "Direct Instruction."

It is to be clear that other treatments were also integrated in this study, with direct instruction being the main one. The secondary treatments also played important roles in the project. Thus the direct instruction approach used in this study needs to be considered as an integrated approach, not an isolated teaching method by itself. The approach has the following features: direct instruction being the main instructional strategy; teachers being trained; with a curriculum design (appropriate for each child); the instructions being structured and focused; feedback to the teachers on adjusting instructional methods and content. The same approach was applied to helping students with severe reading problems and similar results were found (Din, 1998).

Even though the participating teachers in this project were 4th and 5th year college students (in teacher education), it is

possible to train parent volunteers with college or high school level education background with this approach to help children improve their basic skills in math. It would be interesting to implement such a program and to see whether similar results can be generated.

The actual instructions provided to the students included application skills training as part of instructions. Nevertheless, WRAT-R does not measure problem solving skills or application skills. No information of improvement in this area is available.

Conclusion

In this study, direct instruction, applied as a main instructional strategy, with a controlled curriculum (an integrated approach) was implemented to help students with severe math deficiencies. Results indicated that the students made notable gains in basic math skills after receiving the treatments for three weeks. The findings suggest that the integrated direct instruction approach, when used appropriately, can be both effective and efficient in helping students improve their math basic skills.

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